DaimlerChrysler AG

Patent Claims

1. A method for mounting a plurality of add-on parts (3, 3') on a work piece (1), in particular on a vehicle body, wherein the add-on parts (3, 3') are attached to the work piece (1) in such a way that they are oriented with respect to one another in a precisely positioned fashion,

- in which method a mounting tool (5, 5') which is guided by means of a robot (7, 7') is used to feed and position each add-on part (3, 3'), said mounting tool (5, 5') comprising a securing device (14, 14') for receiving the add-on part (3, 3'), and wherein at least one of the mounting tools (5, 5') comprises a sensor system (18, 18') which is permanently connected to the mounting tool (5, 5') and has at least one sensor (19, 19'), having the following steps:
- the mounting tools (5, 5') are moved by means of an iterative closed-loop control process (A-2'), using measured values of the sensors (19, 19'), into a preliminary position (23, 23') in which the add-on parts (3, 3') which are held in the mounting tools (5, 5') are oriented with respect to one another in a precisely positioned fashion,
- the mounting tools (5, 5') with the add-on parts (3, 3') which are held therein and are oriented with respect to one another in a precisely positioned fashion are moved from the preliminary position (23, 23') into a mounting position (27, 27') with respect to the work piece (1), in which position they are connected to the work piece (1).

2. The method as claimed in claim 1, characterized in that within the scope of the iterative closed-loop control process (A-2') by means of which the add-on parts (3, 3') are oriented with respect to one another in a precisely positioned fashion, the following process steps are run through in a control loop:

- (actual) measured values of the sensors (19, 19') are generated,
- these (actual) measured values are compared with (setpoint) measured values generated within the scope of a set up phase,

- a movement vector of the mounting tools (5, 5') is calculated from the difference between the (actual) measured values and (setpoint) measured values using a Jacobi matrix calculated within the scope of the set up phase,
- the mounting tools (5, 5') are moved by an amount equal to this movement vector.

3. The method as claimed in claim 1 or 2, characterized in that, in order to move into the mounting position (27, 27'), a second iterative closed-loop control process (C, C') is run through, in the scope of which the add-on parts (3, 3') which are oriented with respect to one another in a precisely positioned fashion are oriented with respect to a reference area (9) on the work piece (1) in a precisely positioned fashion using measured values of sensors (29, 29').

4. The method as claimed in one of claims 1 to 3, characterized in that after the preliminary position (23, 23') has been reached, the movements of the robots (7, 7') are coupled in such a way that when the mounting position (27, 27') is reached the precisely positioned orientation of the add-on parts (3, 3') with respect to one another is retained.

5. The method as claimed in one of claims 1 to 4, characterized in that the add-on parts (3, 3') are the driver's door (3') and rear door (3) of a vehicle body (1) which are oriented with respect to one another in a precisely positioned fashion and are screwed securely to door openings (2, 2') in the vehicle body (1).

6. A mounting system (4) for simultaneously mounting a plurality of add-on parts (3, 3') on a work piece (1), in particular for mounting two adjacent vehicle doors (3, 3') on a vehicle body (1),
- having a plurality of robots (7, 7') which are each fitted with a mounting tool (5, 5') for receiving an add-on part (3, 3'),
- having a open-loop control system (20) which has, for each robot (7, 7'), a processing program for open-loop controlling the path of the robot (7, 7') and for open-loop controlling the movement of the mounting tool (5, 5'),

- having a sensor system (18, 18') which is permanently connected to one of the mounting tools (5, 5') and comprises one or more sensors (19, 19'),
- wherein at least one of the sensors (19, 19') is directed to a reference area (11, 11') of the add-on part (3, 3') which is held in the other mounting tool (5, 5'),
- and having an evaluation unit (26) for evaluating the measured values of the sensor system (18, 18').

7. The mounting system as claimed in claim 6, characterized in that at least one of the sensors (19, 19') is a metrically noncalibrated sensor.

8. The mounting system as claimed in claim 6 or 7, characterized in that a TCP/IP interface is used for the purpose of communication between the open-loop control system (20) of the robot (7, 7') and the evaluation unit (26) of the sensor system (18, 18').